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(54) APPARATUS FOR SPRAYING PAINT

(71) We, IMPERIAL CHEMICAL INDUSTRIES LIMITED, Imperial Chemical House, Millbank, London, SW1P 3JF, a British Company, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to an apparatus for spraying paint.

The application of paint to a surface of an object by spraying from an air atomisation spray gun is a well known technique, but can lead to substantial losses of paint owing to a carry over of paint in the air flow into regions outside the actual area to be coated. These losses are especially important when using expensive paints, e.g. the electroconductive paints used in the coating of titanium anodes for use in mercury cells. Such losses may be substantially reduced by the use of an electrostatic spraying technique in which the charged paint droplets are attracted to the object to be sprayed. In a conventional electrostatic spray gun, for example, the paint is fed to a gun charged at a high positive potential where it is atomised (e.g. by air pressure or by centrifugal action), and the object to be coated is earthed. It is important, however, to deliver paint to the spray gun at a steady and controllable rate in order to ensure that the object is uniformly coated with paint. Moreover, the uniformity of deposition of the paint may be adversely affected by leakage of electrical charge from the gun, which in turn affects the spraying characteristics of the gun. It is therefore important to provide adequate electrical insulation of the paint spraying system, especially when using electroconductive paints because of their electrical conducting properties.

In practice, a uniform steady flow of paint is not readily achieved. The use of a gravity feed of paint, for example, is unsatisfactory because of variations in flow associated with variations in the head of the paint being fed to the spray gun and because of possible pressure drops in the delivery system. The use of diaphragm pumps is unsatisfactory because of the pulsating nature of the feed. A more positive and efficient metering device is desirable and accordingly we have designed an apparatus which ensures the positive displacement of a predetermined amount of paint to the gun in a smooth and continuous manner, and which is to a large extent independent of pressure drop in the delivery system.

According to the present invention we provide an apparatus for spraying a predetermined amount of paint at a controlled uniform rate which comprises in combination an electrostatic spray gun and a paint delivery device for the gun which comprises a piston and cylinder.

In a preferred apparatus, the cylinder of the delivery device is provided with an inlet for introducing paint thereto, and an outlet through which the paint is delivered to the gun, the said inlet and outlet being provided with independently operable valves. The piston is associated with an actuating means for moving said piston within the cylinder so that when used with a paint, paint is introduced into the cylinder on one stroke of the piston (with the inlet valve open and the outlet valve closed) and paint is discharged on the opposite stroke of the piston (with the inlet valve closed and the outlet valve open). Any conventional actuating means may be used, for example a mechanical actuating means such as a screw jack, or a hydraulic actuating means, for example a hydraulic cylinder coupled to the piston by means of a suitable linkage. The actuating means, whether mechanical or hydraulic, may itself be actuated electrically, mechanically or pneumatically. By "pneumatically" we mean a hydro-pneumatic system in which the hydraulic oil of the hydraulic actuating means is compressed by compressed air. Suitable arrangements include a screw jack or a hydraulic cylinder in association with a variable speed drive electric motor.

The apparatus may suitably include one

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or more piston and cylinder devices for delivering the paint in conjunction with one or more actuating means and one or more electrostatic spray guns. In a preferred arrangement, the apparatus comprises two electrostatic spray guns, each with its own piston and cylinder delivery device, the said delivery devices being associated with a single actuating means. When using a single actuating means in conbination with a plurality of delivery devices and their associated guns, it will be understood that one setting of the actuating means enables each of the guns to operate at the same flow rate.

In practice, it is preferred to fill a delivery device rapidly with paint, while discharging the said paint at a controlled, predetermined and usually slow, rate. The delivery device may be advantageously used to meter accurately very small flows ranging from 1 to 10 ml/minute, for example ranging from 1 to 5 ml/minute. The spraying may conveniently be operated in a batchwise manner by adjusting the rate of delivery to correspond to the overall spraying time required. The operation of any one delivery device including the opening and closing of the valves, or of a plurality of such delivery devices, may be fully automated if desired.

The electrostatic spray gun(s) and the object to be sprayed are conveniently moved relative to one another. It is especially convenient to move the object at constant rate transverse to the electrostatic spray gun.

An embodiment of the invention will now be described, simply by way of example, with reference to the drawing accompanying the provisional specification which is a schematic representation of two electrostatic spray guns in association with two piston and cylinder devices for delivering paint.

Referring to the drawing, the apparatus comprises two electrostatic spray guns 1, 2 in combination with two piston and cylinder delivery devices (designated generally as 3, 4). Each gun 1, 2 is provided with a rotating bell (not shown) for atomising paint delivered to the gun and means (not shown) for charging the gun to a suitably high electric potential relative to the object to be sprayed. Each delivery device 3, 4 comprises a closed cylinder 5, 6 in which moves a piston 7, 8. The cylinders 5, 6 are respectively provided with inlets 9, 10 for introduction of paint thereto, the said inlets 9, 10 being connected via valves 11, 12 and a common pipe 13 and valve 14 to a head vessel 15 for paint. Cylinder 5 is further provided with an outlet 16 for delivery of paint which connects via valve 17 to the head of gun 1. Cylinder 6 is further provided with an outlet 18 for delivery of paint which connects via valve 19 to the head of gun 2. The pistons 7, 8 are connected respectively by rods 20, 21 to a bridge member 22, which is in turn connected via rod 23 to a hydraulically or mechanically operated actuator 24. Operation of the actuator causes upwards or downwards movement of the bridge member 21, which in turn causes the pistons 7, 8 to move upwardly or downwardly respectively in cylinders 5, 6.

In use, a paint is introduced into the head vessel 15 with valves 11, 12 and 14 in their closed position. Valve 14 is opened, followed by valves 11 and 12. The actuator 24 is operated to lower the pistons 7, 8 within cylinder 5, 6, thereby drawing paint into the said cylinders. The valves 11, 12, and 14 are then closed and the valves 17 and 19 opened. The actuator 24 is then operated to raise the pistons 7, 8 at a definite rate, thereby delivering to the guns 1, 2 the desired amount of paint in the desired time (e.g. at the rate of 1 to 5 ml/minute).

It will be appreciated that when electroconductive paint is used, it is necessary to insulate the rods 20, 21 and the bridge member 22, so that the actuating system is electrically isolated from the paint containing system. In practice, the head vessel 15, the pipes 9, 10, 13, 16 and 18, the guns 1, 2, and the cylinders 5, 6, and pistons 7, 8, are all charged to a potential of 100 kV, the rods 20, 21 and the bridge member 22 are insulating, and the rod 23 and the actuator 24 are at earth potential.

The invention is especially applicable to the spraying of electroconductive paints, e.g. the electroconductive paints used for coating of titanium anodes for use in electrolytic cells. Preferred coatings include platinum, platinum/iridium alloys, platinum group metal oxides, particularly ruthenium oxide, and especially mixtures of platinum group metal oxides and film-forming metal oxides, for example ruthenium oxide and titanium dioxide. The platinum metal coatings may be formed, for example, by electrodeposition on the film-forming metal, for example as described in U.K. Patent No. 1,237,077. Platinum group metals and their conducting compounds, particularly oxides, are readily produced by the thermal decomposition techniques, as described for example in U.K. Patent Nos. 1,147,442; 1,195,871; 1,206,863 and 1,244,650.

The invention is further illustrated by the following Example:

Example

Two electrostatic spray guns were arranged, one above the other, so that the one gun was directed on the top half of a titanium anode (14 in. × 10.5 in.) and the other gun was directed on the bottom half. An electroconductive paint composition, consisting of ruthenium trichloride and an organic titanium compound dissolved in an

alcohol, was fed at the rate of 3 ml/minute to each of the guns. At the same time, the titanium anode was moved transverse to the paint sprays at the rate of 1 ft./minute. After spraying, the anode was fired at 180°C to remove the alcohol and then at 450°C to thermally decompose and oxidise the paint constituents to give a coating consisting of a mixture of ruthenium oxide and titanium dioxide. The spraying and firing operations were repeated several times to give the desired thickness of electroconductive coating.

WHAT WE CLAIM IS:—

1. An apparatus for spraying a predetermined amount of paint at a controlled uniform rate which comprises in combination an electrostatic spray gun and a paint delivery device for the gun which comprises a piston and cylinder.

2. An apparatus as claimed in Claim 1 wherein the cylinder of the delivery device is provided with an inlet for introducing paint thereto, an outlet to the gun, and wherein the said inlet and outlet are provided with independently operable inlet and outlet valves respectively.

3. An apparatus as claimed in Claim 2 wherein the piston of the delivery device is associated with an actuating means for moving said piston within the cylinder so that when used with a paint, paint is introduced into the cylinder on one stroke of the piston with the inlet valve open and the outlet valve closed and paint is discharged on the opposite stroke of the piston with the inlet valve closed and the outlet valve open.

4. An apparatus as claimed in Claim 3 comprising two electrostatic spray guns, each with its own piston and cylinder device, and each of said delivery devices being associated with a single actuating means for moving the said pistons within said cylinders.

5. An apparatus as claimed in Claim 3 or Claim 4 wherein a mechanical or hydraulic actuating means is used.

6. An apparatus as claimed in Claim 5 wherein the mechanical actuating means is a screw jack.

7. An apparatus as claimed in Claim 5 wherein the hydraulic actuating means is a hydraulic cylinder coupled to the piston.

8. An apparatus as claimed in any one of Claims 3 to 7 wherein the actuating means is itself actuated electrically, mechanically or pneumatically (as defined herein).

9. An apparatus as claimed in Claim 8 as dependent on Claim 6 wherein the actuating means comprises a screw jack in association with a variable speed drive electric motor.

10. An apparatus as claimed in Claim 8 as dependent on Claim 7 wherein the actuating means comprises a hydraulic cylinder coupled to the piston in conjunction with a variable speed drive electric motor.

11. An apparatus as claimed in any one of the preceding claims wherein the paint is sprayed at 1 to 10 ml/minute.

12. An apparatus as claimed in Claim 11 wherein the paint is sprayed at 1 to 5 ml/minute.

13. An apparatus substantially as described herein and as illustrated with reference to the drawing accompanying the provisional specification.

14. An apparatus as claimed in any one of the preceding claims when used with an electroconductive paint.

15. An apparatus as claimed in Claim 14 wherein the paint comprises thermally decomposable compounds of a platinum metal and of a film-forming metal.

16. An apparatus as claimed in Claim 14 wherein the paint comprises thermally decomposable compounds of a ruthenium compound and of a titanium compound.

17. A method of coating metal anodes with an electroconductive coating using the apparatus as claimed in any one of Claims 14 to 16 and substantially as described in the Example.

18. Metal anodes coated with an electroconductive coating whenever prepared by the method claimed in Claim 17.

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1393333 PROVISIONAL SPECIFICATION

1 SHEET *This drawing is a reproduction of the Original on a reduced scale*